SANITARY INSPECTION OF HOUSES

(2)

BY

W. K. BURTON

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By W. K. Burton.

In reading a paper before you on the subject of sanitary inspection of houses, I do not wish it to be thought that I am going to describe any new system, or to enunciate any new theory with regard to the great question of drainage. What I wish to do is principally to try to give an idea of what is the condition as regards efficiency or the reverse of the drainage arrangements at present existing in the average London house.

In January of 1881 Professor Fleeming Jenkin, F.R.S., read before you a paper, in which he briefly described the objects to be arrived at in draining houses, and pointed out what he considered the best means of enabling individual householders to have these objects carried out. It is the result of work based upon the system then recommended that I shall use to illustrate my paper to-night. Since Professor Jenkin read his paper, 523 houses have been inspected by the association with which I have been connected. The results of these inspections have been tabulated, and defects discovered have been reduced to percentages. The number is such that the percentages may be considered to apply with fair accuracy to all houses of the same class in London ; and here, at the outset, I wish to impress on you the fact that the class of houses the defects of which we are to consider is the very best in London.

I do not propose to enter at all into the subject of rival sewerage systems, nor into the class of evils which arise from breathing air from sewers. I wish,

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however, to point out that where, as in London, the sewerage system is fairly good, dangers to health arise not from the sewers direct, but either from the sewers by means of the house drains, or even more often from the house drains themselves. It is quite agreed by medical authorities that diseases may arise from gases evolved from the drains, or even discharge-pipes in a house, entirely apart from any specific infection such as may be conveyed by means of sewers.

This being the case, it will be seen that the thing which most behoves us is to make sure that the house system is doing efficiently its work. It is evident that the objects to be aimed at in constructing a system of house drainage are as follows :—

First. All matter placed in any of the sanitary appliances in the house must be carried, with the greatest possible expedition, clear of the premises, leaving behind it as little deposit as possible.

Second. All sewer air must be prevented from entering the houses by the channels which serve to carry away the sewage.

Third. Since it is impossible to have house drains absolutely clean, that is, devoid of all decomposing matter, all air from house drains, and even from sink, bath, and other waste-pipes must be kept out of the dwelling-rooms.

To which might be added a fourth, that a constant current of fresh air must be established along every pipe in which it is possible that any decomposing matter may remain, so that such matter may be rapidly oxidised, or rendered innocuous.

The number of houses in which we find the drainage arrangements to be thoroughly good, and to be fulfilling these conditions, is surprisingly small. In fact, I may say, that in all the houses we are called upon to examine, except those which have been arranged within the last dozen years or so, by some engineer, builder, or plumber who has made a special study of the matter, we find defects which interfere with the due fulfilment of one or other of these conditions.

I beg leave to call your attention to a drawing

which I have here (Fig. 1), in which the drainage arrangements are shown to be defective. I have taken such a state of affairs as is by no means uncommon in a London house. I might, by taking separate defects, which I have seen in separate houses, have shown things infinitely worse than I have, but I wished to avoid anything of a 'sensational' character. I would, therefore, have you understand that what is here exhibited is something such as is quite commonly discovered in a London house. I have seen individual houses in which the drainage is more defective. In fact, I should describe the house illustrated now as somewhat below the average of the better class London house, as regards drainage arrangements.

I have alongside of it a drawing which illustrates a well-drained house (Fig. 2). I do not propose elaborately to describe the latter, as my object is rather to point out where defects are to be found than otherwise; but, by its juxtaposition with the first drawing, the defects exhibited in the latter will be made more patent.

The first point to which I wish to draw your attention is the condition of the main drain. It will be seen that it is little other than an elongated cesspool. The size is unnecessarily large. As a consequence, even if it were perfect in all other respects, it would not be self-cleansing, inasmuch as there can never pass down the drain which serves for a single house enough water to scour out pipes of the size illustrated, namely, 9 inch. diameter.

It will be seen, however, that the state of affairs is far from correct, apart from the size of the pipes. In the first place, the joints are not tight; sewage will soak out into the ground through them. In the second place, although there is ample allowance between the two ends of the drain for a good fall, or incline, this fall has all been confined to a few feet of its length, the part underneath the house being laid almost level. This is done simply to avoid the trouble of excavating the ground to a sufficient depth.

Let us now follow the action of a drain of this

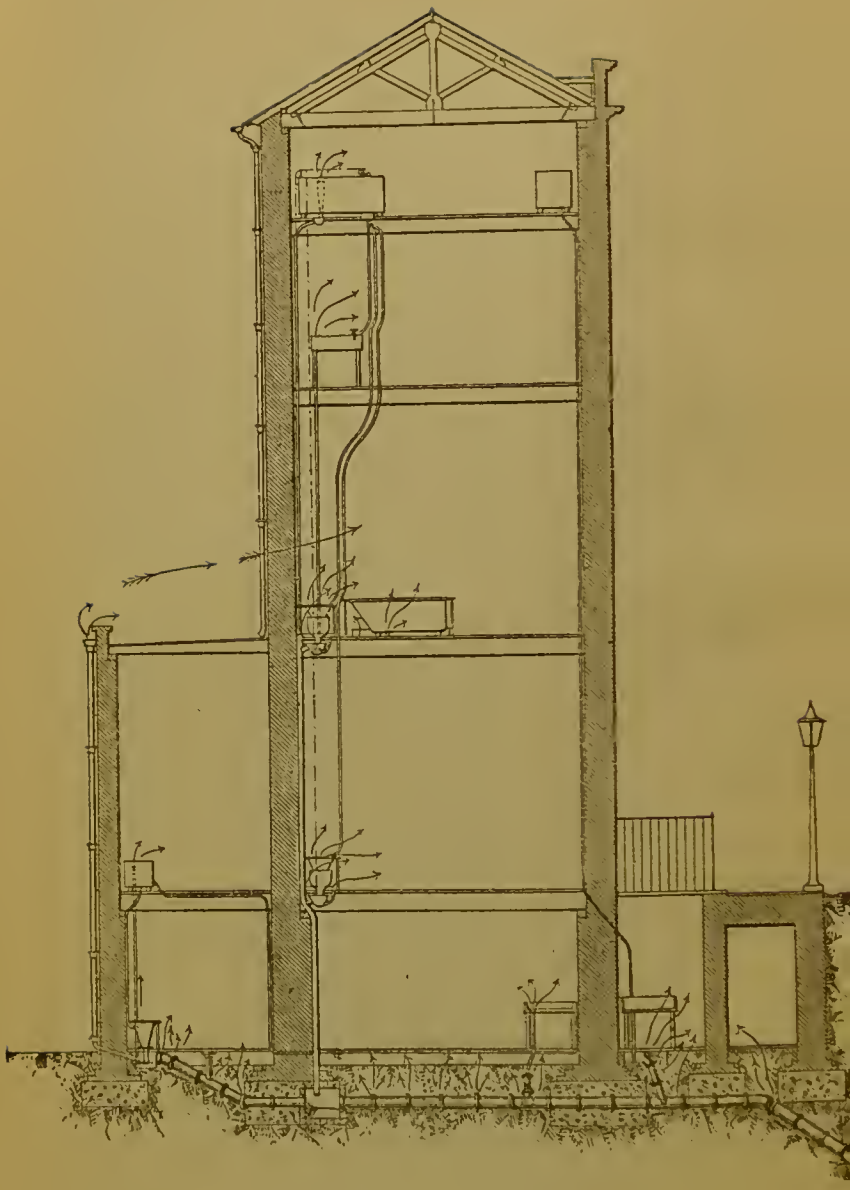

FIG. 1. DEFECTIVE ARRANGEMENT.

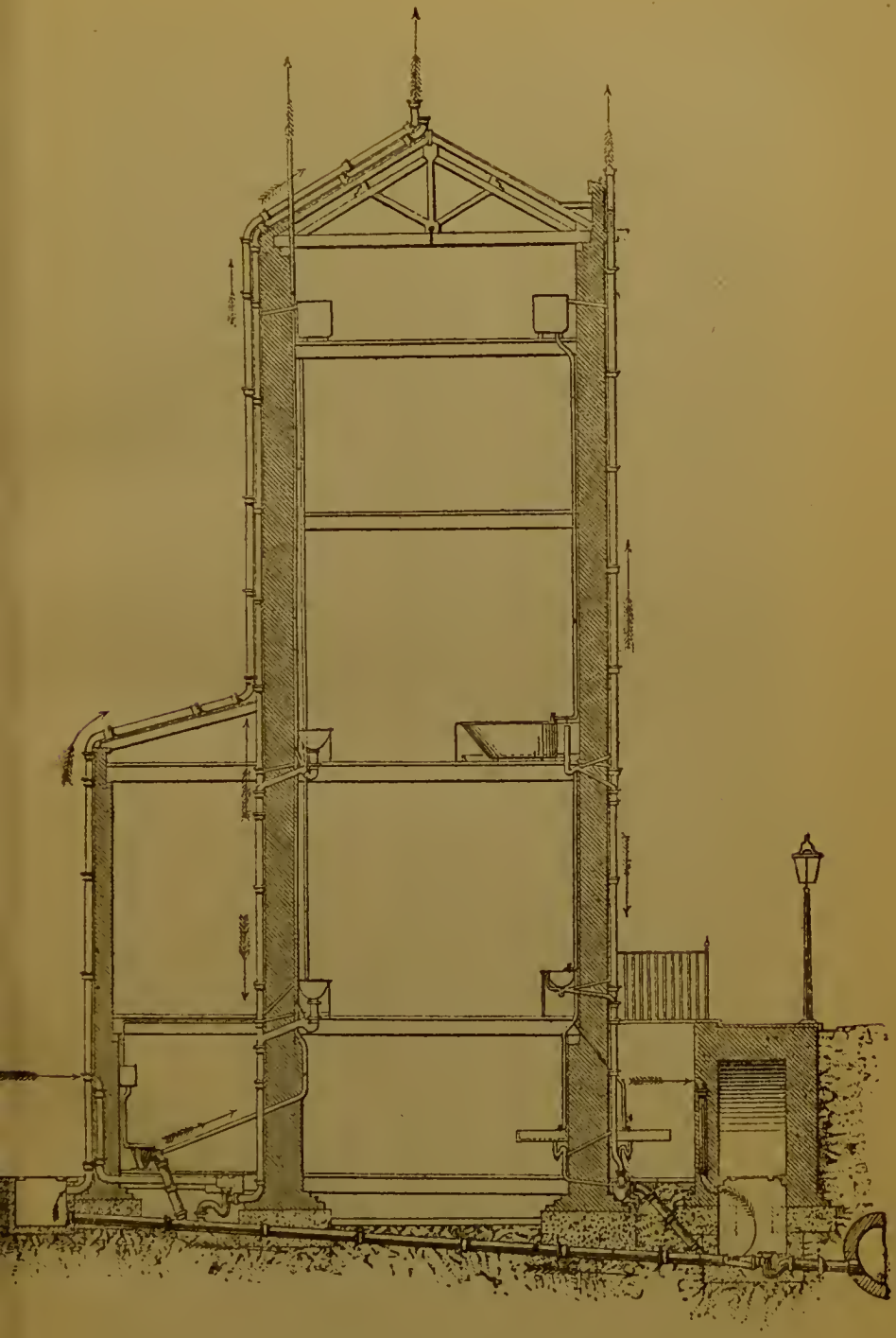

FIG. 2. WELL-ARRANGED HOUSE.

kind, and see what it will lead to. Sewage matter finds its way into it. As we all know, this matter depends on water to carry it forward. It is probable that, while the drain is new and the ground comparatively solid around it, sufficient water will remain in it to carry the greater part of the sewage to the sewer. But this state of affairs will not last. Before long, some unusually heavy or obstinate matter will get into the drain. It will be carried only so far, and will then stick. Any water now coming behind it will 'back up,' to a certain extent, and will very soon find its way into the soil, from one or more points behind the obstruction—not yet amounting to a stoppage. As a consequence, sewage now passing into the drain, loses its carrying power, and gets no farther than a certain distance. Before long, a complete stoppage takes place, and all the sewage of the house soaks into the ground under the basement. After this, things go from bad to worse. The saturated ground no longer properly supports the pipes, which, as a consequence, will become more and more irregular, and all hope of the drain clearing itself is lost. It is only a question of time, with a drain such as I have shown, and the inmates of the house will be living over a cesspool.

As a matter of fact, total obstruction or stoppage has been discovered in 6 per cent. of the houses which we have inspected.

The next point worthy of attention is the soil-pipe ; this term being at present used to signify the vertical portion of the drain only, although it very often is also used as meaning the almost horizontal drain under the house.

It will be seen that the soil-pipe is of lead. This is an excellent material if the pipe be properly arranged, but here it is not. The great fault is that there is no ventilation. As a consequence, the upper part of the pipe will always be filled with sewer gas, which tends to rise in a somewhat concentrated state. Now, sewer gas has a powerful action on lead, and, therefore, a soil-pipe arranged without ventilation never stands many years before it becomes 'holed,' that is to say, is worn through at its upper

part. When this occurs, of course there is ventilation enough, but it is into the house. The ventilation in this case will in fact be most active, because every house, on account of the fires in it, acts, especially in winter, as a chimney, and draws in sewer or other gas from every possible crevice.

At the top of the soil-pipe will be found the commonest of all water-closet arrangements, namely, the pan-closet with D trap. I shall not describe this arrangement in detail; it is exceedingly well known. I may merely say, that it is a most skilfully devised piece of apparatus for retaining sewage in the house and distilling sewer gas from the same, and that it is the cause of probably nine out of ten of the actual smells perceived in houses, even if it does not (as some say) give rise to much actual disease.

The soil-pipe discharges over a small cesspool at the foot. This is a very common arrangement. The cesspool is usually dignified by the name of a dip-trap. The percentage of houses showing leaky soil-pipes is thirty-one.

Now, observe that, although our constructor has not ventilated his soil-pipe, he has been careful not to leave the system entirely without ventilation. On the contrary, by the simple device of leaving a rain-water pipe untrapped at the foot, he has ventilated the drains, and also the public sewer, into the back bedroom windows! This is a quite common arrangement. I have, within the last two months, seen two cases in which it has resulted in typhoid fever. In each case, children slept in rooms, the windows of which were within a few feet of the upper ends of rain-water pipes, left untrapped, either through carelessness or through the idea that they would be useful as ventilators.

Next, in order, we may take the case of the discharge-pipes from baths, sinks, basins, and all such appliances. It has been laid down as a rule by the best sanitary authorities that these appliances must discharge not into the soil drains, but into the open air over trapped gullies, as it has been found that this is the only way of being absolutely certain that no sewer air shall enter the rooms by the discharge-

pipes. It is quite true that if a trap be fixed on the discharge-pipe of, say, a sink, the greater part of the sewer air may be kept back from the house; but traps, however excellent they may be in *assisting* to keep out sewer air, are not alone sufficient. There are several reasons for this. In the first place, there is the fact that a certain amount of sewer gas will pass through the water of a trap, or, to speak more strictly, will be absorbed by the water on one side, and afterwards given off on the other side. It is true that in the case of a well-ventilated drain this amount will be infinitesimal, and might even be disregarded, but there are other causes for the uncertainty of a trap. If the appliance on the discharge-pipe of which it is be disused for a long time, there is the possibility that the water in the trap may dry. In this case, of course, there is no further security. Besides this, however, there is an action known as syphonage, in which the rush of water through a pipe carries with it the water which ought to remain in the trap and form a seal. In the drawing there are shown several different ways of connecting sinks, &c., with drains. In a separate drawing (Fig. 3) there is shown on a larger scale, so as to make it more distinct, a portion of the drain with two sinks discharging into it. In the one case, there is on the discharge-pipe an apology for a trap, in the form of a little apparatus called a bell-trap. I have such a thing on the table, and you will readily be able to see that, at the best, the security afforded by it is but slight. But, as a matter of fact, it is the commonest thing possible to find the bell-trap in the position shown in the drawing—that is, lying on the sink. It has been lifted out of its place to let the water run down the waste-pipe more quickly. It is no unusual thing to go into the scullery of a house and to find the discharge-pipe of the sink quite open, as is shown, and a blast of sewer air issuing from it which will extinguish a candle.

In the case of the other sink there is shown an arrangement which is called a grease trap, but is in reality, nothing more nor less than a particularly foul cesspool. It calls for little remark. You will

see that the pipe from the sink dips into the foul water to make a trap. In many cases the pipe does not dip into the water; but there is a bell at the top, as shown in the case of the other sink. On three occasions, when I have lifted the bell from such an arrangement, and applied a match the foul gas has actually caught fire, burning with a blue lambent flame. It will be noticed in this drawing that the drain is at various places made up with bricks. This is a very common thing to find in houses. The bricks are used to save the trouble of getting special junction bends, &c. The other sinks and baths in

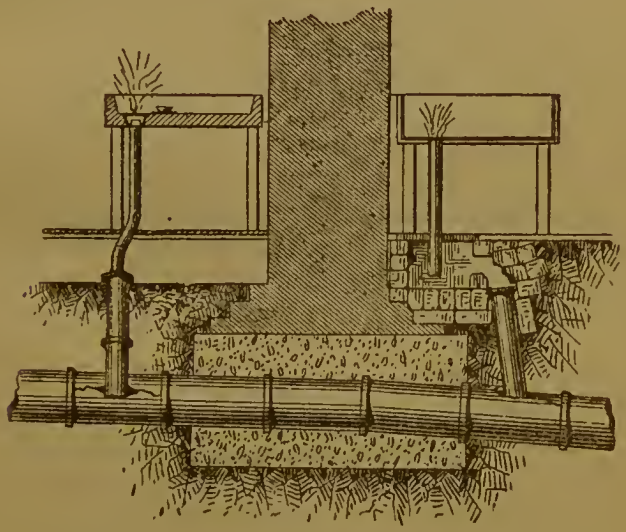

Fig. 3.

the house are shown as discharging into the closet traps. This is a very common and objectionable arrangement. Sixty-eight per cent. of houses examined show the defects last mentioned; that is to say, the sinks, baths, or fixed basins are connected with the drain or soil-pipe, a trap of some kind generally, but not always, forming a partial security against sewer gas.

As mentioned before, the only ventilation in this case is such as will permit the issuing sewer gas to find its way into the house. It is by no means unusual to find no provision at all for ventilation, or

to find the ventilating pipes so small that they are totally useless. In more cases than one I have found the soil-pipe carried up as a rain-water pipe into the attics, where it received rain water from two gutters, one from each side of the roof, and discharged all the sewer-gas which escaped by it. Generally, the drinking-water cisterns are situated in such attics.

It may be noted, in the other drawing (Fig. 2) that a trap is fixed on the main drain, which will keep back almost all sewer gas, and that ventilating-pipes are so arranged that a constant circulation of fresh air exists through the whole drainage system, and will carry away with it any little sewer gas which passes through the trapping water.

Whilst on the subject of ventilating-pipes, I must not forget to show to you a somewhat curious case of obstruction of a ventilating-pipe. I have the top portions of the pipe in question here. There were two such 4-inch pipes, acting as the ventilating-pipes of the house drains of a well-known scientific professor in London. In each case, as here seen, there was a bird's-nest completely filling up the top portions of the pipe.

We shall now pass on to the water-supply arrangements in the house. I need scarcely say that the most perfect water-supply arrangement does not necessitate the existence of cisterns in the house at all. This is beside the mark, for the reason that in London, to which I wish to confine my remarks, the supply of water to the greater portion of the town is intermittent, so that cisterns are a necessity.

Water, even in London, is almost always delivered in a sufficiently pure state to be drunk, but it is a very common thing for it to be contaminated in the cisterns. Even if there be no actual disease germs carried into the water, there is liability of deterioration from the mere fact of a large quantity of water being stored for a long time before use. If the cisterns are of so great size as to hold as much water as is used in, say, three or four days, it follows that all water drawn has remained in these cisterns for an average time of several days. This is by no means

likely to improve its quality, but, on the contrary, if it does nothing else, it renders it flat. There are far more dangerous causes of contamination than this, however. The commonest of these is to be found in direct communication between the drains and the cisterns through the overflow pipes of the latter. This is shown on the drawing. It will be seen that there is a trap on the pipe by way of protection against the sewer gas. This is a by no means uncommon arrangement ; but, as will be readily understood, such a trap is absolutely of no good. An overflow pipe to a cistern is merely an appliance to be put in use in case of an emergency ; that is, in case of derangement of the ball valve through which the water enters. As a matter of fact, an overflow may not occur from year's end to year's end—probably does not—and, as a consequence, the trap soon becomes dry, and the temporary security afforded by it is lost. In 37 per cent. of houses inspected we have found direct communication between the drain or soil-pipes and the drinking-water cisterns.

Another means by which the water of cisterns is contaminated is by their being placed in improper positions. Quite frequently, a cistern in which drinking water is stored, is situated in, or even under, the floor of a W.C. I have known more than one case in which the drip-tray under a closet actually discharged into a cistern.

It is even possible for contamination of water to occur through the mere fact that a water-closet is supplied from a certain cistern. With a water-closet supplied by the modern regulator valve apparatus, this is most unlikely ; but it will be readily seen how it may occur with such an arrangement as that shown on our drawing, which is common. Here it will be seen that for each water-closet there is a plug in the cistern. This plug is so arranged that when it is raised by the wire which connects it with the water-closet branch, it suddenly fills what is called a service-box, this being a subsidiary cistern fixed under the body of the main cistern, and in direct communication with the water-closet. After the water has run out of the service-box, this is free to

fill itself with foul gas from the water-closet by the service-pipe, and the next time the plug is lifted this same foul gas passes into the water, which absorbs a part of it.

There are many other points in the drainage arrangements of a house which may possibly become causes of danger, such as surface traps in areas, &c., but I shall not take up your time with a description of these to-night.

I have, in talking of the drain of a house, considered it as a single length of pipe ; but it must be remembered that in any drainage system, except the most simple, there are branch drains, often many of them, and that these are liable to the same evils as the main drains, and require the same attention. In fact, seeing that less water is likely to pour down them, they require more attention.

A paper on the subject of inspection of houses would be quite incomplete were it to contain only an account of the defects to be found, and to leave out altogether any description of the methods in use for discovering such defects. To describe to you fully how this is done, would be quite beyond my scope to-night, as it would take up much time ; moreover, it is impossible to depend in all cases on any one set of methods, the general intelligence of the inspector being the thing which is of most consequence.

Looking at the diagram before you, where the house and ground are in section, and where, so to speak, you have the power of seeing through walls, soil, flag-stones, and so forth, it doubtless appears as if it must be an easy matter for a man to lay his finger on each and every fault and say ' this is wrong.' But try to transfer your minds from this diagram to any house of which you know the exterior parts, but of which you have seen no section, of which you do not know where or in what direction any of the drains or pipes run, or even if there are any, and it will be evident that the matter is not so easy as at first sight appears.

I shall suppose just such a house as the one here illustrated to have come under the hands of one

wishing to inspect it, for the purpose of discovering what are the faults of the drainage system.

One thing that is absolutely necessary for such inspection, and without which it would be quite incomplete, is to open down to the drain. This should be done at the nearest point to that at which it leaves the premises. There is no absolute guide to tell where this point is, but after some experience it is generally possible to hit upon the spot with very little searching. In the house illustrated it would be under the front area or cellar. The ground should be entirely removed from the drain for at least two lengths of pipe. I should here mention that in the drawings all the dimensions from back to front, such as width of area and cellar, have been somewhat compressed to allow of showing the pipes on the largest scale possible. It is also very desirable that a portion of the ground over the top portion of the drain should be removed.

We may next take the point of trapping of the main drain and ventilation of the system. It will be seen that, in the case of the drawing of the imperfect arrangements, the drain is shown to be in direct communication with the sewer. The consequence is that any leakage which may exist in the house drain permits gas not only from the drain itself, but from the sewer also, to find its way into the house.

The engineer will now be able to tell much of the state of affairs. He will see of what size the drain is ; he will be able to tell of what material the joints are made, taking those exposed as samples ; he will, in all probability, find the ground under the pipes soaked with sewage, and be able at once to say that the drain is in a leaky and bad condition ; he will find whether it is properly supported on concrete, or has been 'tumbled' into the soil ; he will be able readily to discover what is the total fall in the drain from back to front. At this stage of the proceedings the drain itself should not be opened, but, on the contrary, if the taking up of the ground should have exposed any joints which are evidently leaking, these should be made temporarily good with clay. The reason is, that it is desirable, before anything has

been disturbed, to test the system for the purpose of discovering what amount of leakage there is into the house.

There are various ways of doing this, but the two commonest, which I intend to describe and illustrate to you, are those known as the 'peppermint test' and the 'smoke test.'

The smell of peppermint is well known, possibly to some of us unpleasantly well known, but probably its excessive pungency when in the form of the oil, and when brought into contact with hot water, is not generally understood. I have here a pail of hot water and a bottle containing a little Mitcham oil of peppermint. I shall pour only a drop or two of the oil on to the surface of the water, when I imagine the smell will instantly be unmistakably evident throughout the hall.

It will readily be understood that if such an excessively pungent mixture as this be introduced into the drainage system of a house, even the smallest leakage will become evident. Suppose the least possible defect to exist in any joint of any of the pipes, a strong smell of peppermint will be evident near the defect. The only difficulty is finding a place to introduce the peppermint. It will be quite evident that it is no use to pour it into any of the appliances in the house, as, were such done, this smell would so rapidly permeate the whole of the premises, by way of the staircase, passages, &c., that time would not be allowed to detect the leakages. Some means must be discovered of getting the peppermint in from the outside. This is not always possible, but generally it is. In the case illustrated there would be no difficulty. The rain-water pipe at the back admirably suits the purpose. One person gets out on the flat roof, near the top of the pipe, and provides himself with peppermint and four or five gallons of water, as near boiling as possible. Meantime all doors and windows are closely shut, and persons are stationed about the house to observe if the smell expected becomes evident, and to locate, as far as possible, the point from which it issues. The man on the roof pours about half-an-ounce of the oil

down the pipe, and follows it with the hot water. He need then retreat from the place a little, for the peppermint-laden steam which will come from the pipe is blinding in its pungency. As soon as possible he plugs up the top of the pipe with a towel, or some such thing, to prevent the occurrence of the vacuum which would otherwise be in the pipes, and which would tend to draw air from the house into the pipes instead of from the pipes into the house at any leakage. It would probably not be a minute before the people in the house would perceive the smell at various places. The manipulator of the peppermint must remain perched on the roof until those inside have had time to make their observations, otherwise he will infallibly bring the smell with him.

The test described is an excellent one. It is searching, and is simple in application, but it has one drawback. It is impossible by means of it exactly to localise a leakage. This drawback does not apply to the smoke test. Here I have a smoke machine. This is nothing more nor less than a centrifugal pump attached to a vessel for generating smoke. The pump pumps smoke out by this pipe, which may be inserted in any pipe in direct communication with the drain or in an aperture made for the purpose. I give you an example of its powers. Merely a puff, as I do not wish to smother my audience.

The test is in all respects similar to the peppermint one, except that the leakage is not smelt but seen, and, as we all know, seeing is believing.

After the test has been performed the drain may be opened. This may be done by breaking into a pipe in front, by breaking off a collar, or by punching a round hole in the pipe. In any case it will be possible to judge much of the condition of the drain by the manner in which water runs through the pipes. If we have discovered that there is sufficient total fall, we can now see whether or not it is uniform. We shall, as remarked before, find in six cases out of every hundred examined that there is a total stoppage, that no sewage whatever leaves the premises, and that consequently it must all be depositing under the basement.

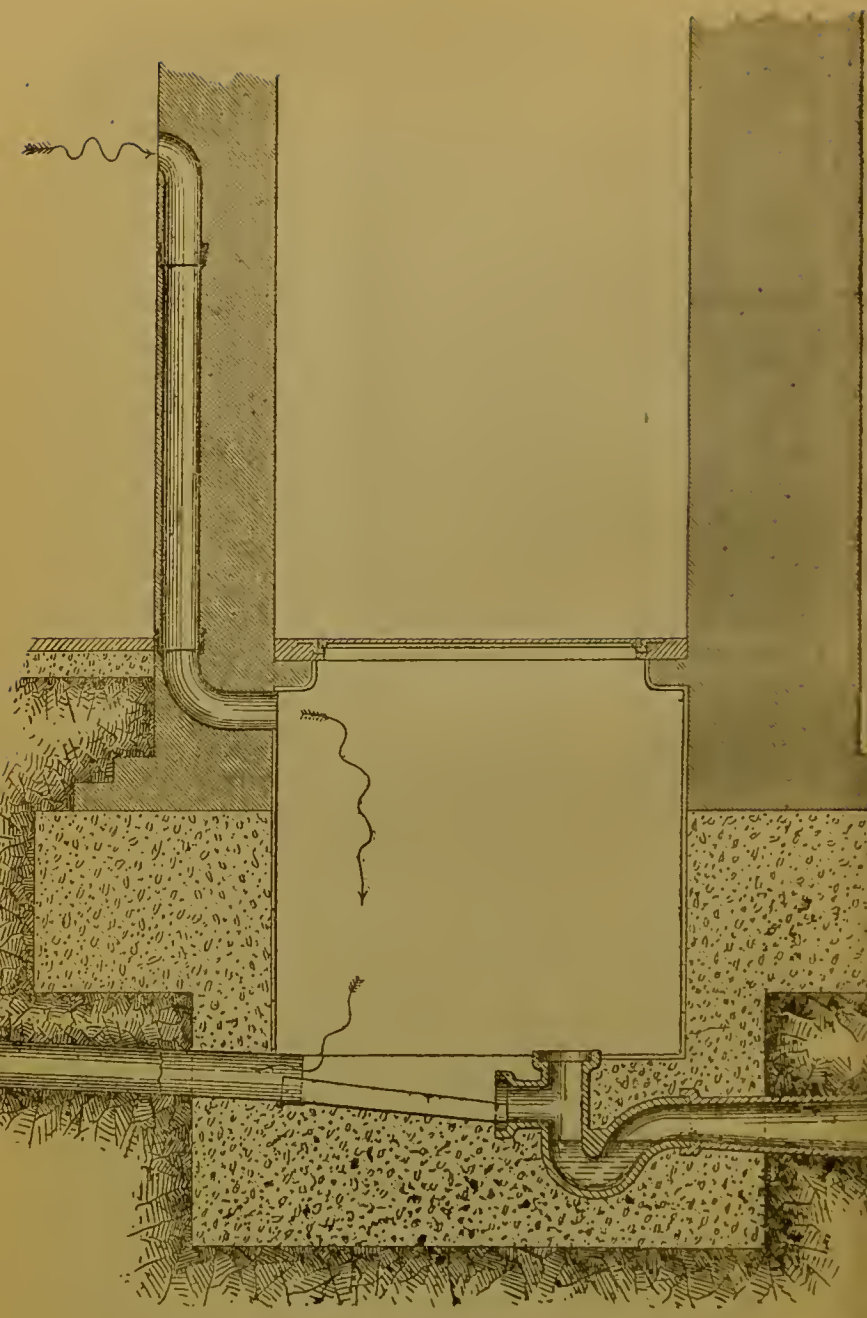

FIG. 4. DETAIL OF DISCONNECTION CHAMBERS IN FIG. 2.

If the drain, after all tests so far applied, and from what can be seen of it, appear to be in good condition, it may be further tested by filling, or attempting to fill, it with water. There is probably not an average of one drain in a thousand in London which would remain full of water for an hour. For the rest it is necessary to examine all appliances, to trace the pipes from them, and sometimes to test these pipes.

The engineer has now completed his inspection, and has but to consider how he will make the best of a bad job, and put things to rights. At the beginning of my paper I expressed my intention of confining myself to a description of defects, and said I should not describe what I considered a perfect system. I shall, however, point out to you one or two of the chief features of the arrangements in the house which I call well drained.

Most notable, probably, is the small size and sharp fall of the drain-pipes. Further than this, it will be seen that the drain is disconnected from the sewer by a trap, and that it is accessible for inspection throughout, simply by lifting certain iron covers (Fig. 4). A close examination would show that every foot of drain-pipe and discharge-pipe is so ventilated that there will be a current of air through it; that no appliance discharges into the drain direct, but that there is an atmospheric disconnection in every case; that air from discharge-pipes of sinks, &c., is all trapped from the house; that there is separate water supply for closets, and for other purposes; and that no cistern has any connection with the drains. Further will be noticed the difference in construction of the closets, &c.

I have in this paper confined myself to the subject of the drainage arrangement of houses. It must not for this reason be supposed that I am blind to the questions of heating, ventilation, and so forth; on the contrary, I beg you to understand that I consider these questions most important, but that time will not allow me to enter into them.

I shall finish my paper by repeating a warning given to you by Professor Fleeming Jenkin when he

spoke before you two years ago. He warned you against sanitary enthusiasts, against the man who will hear of nothing less than the pulling down and rebuilding of your house; who will not allow you to have wall-paper, carpets, or even wooden floors, but who insists on tiles and such like everywhere; who insists that not a drop of water shall be drunk unless it is analysed; and who, did he have his way, would verily make the life which he attempts to protect not worth living. Against such I too would warn you. Remember that in going beyond a certain point you are straining at a gnat whilst you swallow a camel. In a city like this every cubic foot of air which you breathe carries with it a certain percentage of sewer gas; and if, in regard to your own house, you see that the conditions enunciated in the beginning of my paper be carried out, this percentage will not be appreciably added to by any fault over which you have control.

I have to thank certain gentlemen for the assistance they have rendered me to-night in enabling me to show you these examples of how not to do the thing. These are Mr. Hellyer, Mr. Lucas, Mr. Francis Botting, Mr. Clemence, Mr. Scott-Moncrieff, of the North British Plumbing Company, and his representative, Mr. Dodds, who has shown the smoke machine in action, also Mr. Robert Davies.

Discussion.

Mr. Robert Rawlinson, C.B., said he quite agreed with Mr. Burton that houses required careful examination, and if this had not been done recently the chances are that they were in a bad condition. He spoke from experience of houses of all classes—from Windsor Castle down to common lodging-houses; and though what had been said was not new to him, there was abundant necessity for its being repeated incessantly. He often found that persons, though they acknowledged that their houses were defective in sanitary matters, yet shrank from the expense

necessary to put them right. Such persons were, in his opinion, most foolish ; for nothing was of any value compared to human life and health. If a man could only by the greatest possible shifts spare what was requisite to put his dwelling-house into proper order, he would if he were wise make the effort, because it was the foundation of the health of himself and his family. He was very sorry that in many cases the process was a very expensive one, though when houses are properly built from the beginning it would be very cheap. One principle which should never be departed from in the construction, whether of a palace or a cottage, was that no drain should be laid under any portion of the building. In London, where houses were built in streets—with the kitchen, scullery, and closet at the back, and the main sewer in front—it became necessary to drain under the houses ; but in such cases cast-iron pipes with lead joints should be employed, with ventilation back and front, and thus any chance of sewer gas entering the house might be avoided. Even the best stoneware pipes were liable to crack and leak at the joints. Another prevalent evil was that the main sewers in some of the London parishes had not proper and safe junctions provided for the entrance of the house drains, so that the sewer had to be broken into for the purpose ; and very often a fine was also levied for entering the sewer, which was practically a premium to the builder not to connect the drains. This was the case with many houses in the west of London ; and even when the connection was made it was not done properly, so as to prevent the inlet of air from the sewer into the house drain.

Mr. Rogers Field said he found from an experience of eight or ten years in these matters that the majority of houses were very defective, and out of about a thousand he had examined he had only found three which were sound. It was impossible to tell whether a stoneware drain was sound without thoroughly testing it with water, and very few indeed would stand the test. In New York the difficulty had now been so recognised of making good joints

in such pipes that a regulation was passed that all drains under houses should be of cast iron, jointed in the same way as water or gas pipes. The sink-traps, which had been referred to, were a constant source of danger. Though defects in them were not always discovered without a careful examination, he was sorry to find they were still being constantly used even in large houses.

Mr. E. P. Bailey Denton said all sanitarians were agreed as to the mode of remedying the evils which had been described, and it only remained with the public to have the remedies carried out. One or two points he thought had been omitted. For instance, the danger from the waste-pipes of safes under water-closets and baths, and the great importance of disconnecting the house drain from the sewer had hardly been dwelt upon sufficiently; nor was the best method of ventilation sufficiently explained, to make the public see the necessity for it. The flushing of drains was another point of importance. He agreed with Mr. Burton that the theories of sanitarians must not be pushed too far, and he would ask him whether there was not a possibility of falling into this danger, by insisting rigidly on an entire separation between the drinking-water cistern and the one for supplying the water-closet in cases where improved closets were used, the pipe supplying them being always full of water.

Mr. E. C. Robins said he could confirm everything stated by Mr. Rogers Field as to the difficulty of laying stoneware drains perfectly; for he had never found one which would stand the test of water being put into it. He had used iron pipes, and had formed a subway under the house, in which all pipes were carried. With iron pipes properly leaded, both for drainage and ventilation, he had been able to dispense with traps altogether. Earthenware pipes required the very greatest care in laying, and yet, as a rule, builders employed common labourers for this work. Some employed bricklayers, and where great care was used the result might be satisfactory. He agreed with Mr. Bailey Denton as to the importance of flushing, and had

been very much pleased with Mr. Rogers Field's siphon apparatus for this purpose ; it could be so arranged that, according to the rate at which the water was allowed to flow into it, the drains could be flushed twice or three times a day, or oftener. The paper, though it contained nothing new, was very valuable, and the percentages given would be very useful.

Dr. Bartlett said there were other means, besides those which had been mentioned by Mr. Burton, for detecting the escape or presence of what was often called sewer gas, but which he preferred to call sewer air. Musk, for instance, was not a gaseous body, and made its presence apparent by the diffusion of very minute particles ; but there were other substances, the detection of whose presence did not depend on the olfactory nerves, and about which there could not possibly be a mistake. If acetate of lithium were passed down a drain, its presence could be detected in the spectroscope by its characteristic line ; tellurium again gave another definite indication. He had tried these two substances, putting them into the water supply, and detecting their presence in the sewers twenty minutes afterwards ; and, on one occasion, on putting them into the sewers he had detected their presence in the water supply in an hour and a quarter. He endorsed everything which had been said as to the importance of not admitting sewer air into houses. He had seen a large building of the best description, in which there was the entire accumulation of six years, not one particle having passed into the sewer. The importance of disconnection was not, he held, as new as some people supposed, the old-fashioned method of a privy at the end of the garden being an exemplification of it. In many cases the sewer was an elongated cesspool, and by the process of fermentation not only gaseous matters but solid matters, which were contagious as well as infectious, were carried into the house, and if they did not cause specific disease, caused that condition of lowered vitality which predisposed to every kind of disease.

Mr. William Botly said he had known, within a

short period, two cases of typhoid fever arising from defective drainage in houses of a rental of about 200*l.* per annum ; and in a recent case the stoppage in the pipes was occasioned by an accumulation of fat. There was nothing in the paper about compulsory inspection, but he considered that most important. Not long since he saw a row of large houses within the four-mile radius from Charing Cross, some of which had been occupied several times, although they were unconnected with the sewer. It ought to be compulsory on architects and builders to see that the connection was properly made. In his native city, Salisbury, where great attention was paid to sanitation, the death-rate had been reduced from 27 to 17 per 1,000.

Mr. Collins said reflections were often made on architects with regard to these matters ; but there were probably not more than 5 per cent. of the houses built which had the advantage or disadvantage of an architect's superintendence at all. He agreed that there was a difficulty in laying down stoneware drains satisfactorily, but it could be done ; the greatest difficulty was to get the work properly carried out, and it could only be ensured by having some one to inspect its progress throughout. He had frequently found a most admirable system fail from defects in carrying out the work, and it was therefore very important to have a simple system which would admit of easy re-inspection. He had used Mr. Field's siphons very largely, but they were so powerful in action that they sometimes emptied the traps. This could easily be obviated by a practical man, and did not detract from the value of the siphon, but it required to be borne in mind. It had been said that there ought to be compulsory examination of every house, but it was already provided by the Metropolis Local Management Act that no house should be even inhabited until it had been certified by the surveyor of the parish. Being a vestryman of Paddington, he had often tried to get this carried out, but the answer always was that it would require too many clerks to carry it into execution. Another important matter was the

financial question. A man would willingly spend 40*l.* or 50*l.* to put his house in order, but was deterred by the very large expense some specialists would put him to. He knew an instance of a public institution where a difficulty occurred owing to the expense, which was estimated at 550*l.*, but he had all that was necessary done for 220*l.*

Mr. C. N. Cresswell said the technical part of the subject had been amply discussed; but there was a larger and important aspect of the question to be considered. How were the terrible mischiefs to be remedied? He was glad to see so many ladies present, for they were even more interested in this question than men. The evil was most rampant in the suburbs of London, where houses were increasing at the rate of tens of thousands a year. It had been said in that room, by men not given to exaggeration, that of these houses not 20 per cent. were fit for habitation. How was this great evil to be dealt with? Mr. Burton represented a most excellent institution, and there were most eminent men connected with it, but how could any society deal with so vast an evil? Whilst it was dealing with about 200 houses in a given area, houses were increasing by thousands around them. It was perfectly clear to him that neither philanthropic nor commercial enterprise could deal with this matter properly; it was an affair of the State. The State had taught them, by the Act of 1875, and by the model bye-laws issued from the Local Government Board, how to deal with the difficulty, and there was no necessity for further legislation. If the bye-laws were only put into operation, and men were found able and willing to do it, and the ratepayers would find the money, there would be no difficulty; but there was the real pinch of the matter, the apathy of the public, and that love of buttoning up his breeches pocket which distinguished the British subject. The dictates of science could only be enforced by the arm of the law, compelling the ratepayer to do that which would conduce to his own good and that of his neighbour. It could only be carried out by the principle of local self-government; but there were

two sides of the question, dealing respectively with houses already built, and with those about to be erected. They were informed on high authority that while it would cost perhaps 150*l.* to put an existing house of 200*l.* a year, full of defects, into a proper state, 50*l.* would cover the expense if it were done in the building. The only way of approaching the British subject was by showing him that it was worth his while to do what they all agreed was his duty, and as to the manner of doing which all competent authorities were also agreed. He believed this would be accomplished if an official certificate, sealed with the seal of the local authority, were given him, testifying to the healthworthy character of his house, as that would immediately increase the letting or saleable value of his house by the amount he had expended. This certificate should state what had been done, and contain on the back of it a plan of the drains, and, issuing from an independent local authority, would be regarded as an increment of value to the tenement in the hands of the owner.

Mr. Liggins said they were all much indebted to Mr. Burton ; but the weak point in the paper was that it did not say where the requisite scientific knowledge was to be obtained, which would enable them to get defects in drains detected with certainty. When some of the finest buildings in London, belonging to the Government, were recently amongst the most defective, how could private individuals expect to get their work done properly ? The Vestry of Kensington took up this subject very warmly some four years ago, but they found there were no clauses in the Act of Parliament sufficiently strong to enable their surveyors to carry out the rules which they made. If they could get such certificates as Mr. Cresswell had spoken of, no doubt these would be very valuable, but under the present law it could not be done. Again, when they found experts differing on certain technical points, how could the public decide between them ? He believed the evil was much exaggerated by sanitary engineers, and that water-closets and drains did not generally communicate with the drinking water.

Mr. G. E. Mineard wished to say a few words from the builders' point of view. He had a copy of a report on a house which had been arranged on the system described by Mr. Burton, in which an expert suggested that the manhole should be closed, and the iron ventilating-pipe removed, and replaced by a common zinc ventilator. How, then, was it possible for a builder desirous of carrying out the best system to do so? His own experience was, that the sewer gas would come out at the place where Mr. Burton said the fresh air would go in; in fact, he tried that plan years ago, and found it a failure. The air going up through the soil-pipe must be met by the volume of water and sewage coming down, of 800 times its specific gravity, and any sane man must see that the current being reversed, it must blow out into the area. Everyone who had written on this subject admitted that they could not tell at all times which way the air would be going. As for sanitary defects, there could be no doubt there was room for improvement on every hand. He had seen drains taken up at Sandringham House in which he could lay his hand, and at Eastwell Park he had taken up one which was 18 ins. thick with solid sewage, and yet that was supposed to have been put into proper sanitary condition within eight years, under the supervision of a first-rate sanitary expert. How, then, could the public know whom to apply to? He believed if any good were to be done they must have an Act of Parliament. First settle what was the best thing to be done, and then make everybody do it. At present all was confusion, and many of the sanitary engineers were grinding their own axes by frightening the public. He had had a bell-trap, with all its imperfections, prescribed by a surveyor, and had had within the last three months to connect safes with waste pipes, by order of a surveyor. If the Board of Trade, or any responsible body, would undertake for a certain fee to indemnify him against others coming to upset what had been done under their supervision, he would willingly go in for it. At present, a builder, however conscientious, had no safe guide, and con-

sequently the public did not appreciate sanitary appliances. If the gentlemen who preached this doctrine would only build some sanitary houses, and invite people to see what could be done, something might be learnt ; but at present the whole thing was in a state of chaos.

The Chairman in proposing a vote of thanks to Mr. Burton, said the result of the whole discussion was to show the great importance of thoroughly educating the public in the matter. He could not agree with the last speaker in wishing that a hard and fast rule should be laid down by Act of Parliament, for if that had been done eight or ten years ago, they would have been much less advanced in sanitary matters than they were at present ; and he did not think they had yet reached absolute perfection in sanitary science. He hoped they would still go on striving and educating themselves, perhaps by occasional failures, until they had obtained a higher degree of excellence.

The vote of thanks was passed unanimously.

Mr. Edwin Chadwick, C.B., who was unable to attend the meeting, writes to the secretary that he considers the statement of the varied experiences of skilled specialists in house drainage of the highest sanitary importance, and Mr. Burton's paper as most valuable, more especially the remarks on the application of the peppermint test.

The following is sent to us by Mr. Burton as the reply which he would have made upon the discussion had there been time to deliver it :—

'It is perfectly true that there is nothing new to sanitarians in the paper which I read, nor did I intend that there should be. It would ill beseem me to try to teach such men as Mr. Rawlinson, Mr. Field, and others who attended my lecture. My remarks were intended for the general public, and a proof that the general public is not aware of the facts stated is to be found in those very facts themselves. If the public knew in what condition their

homes were they would take speedy steps to remedy it.

'With regard to what Mr. Rawlinson said about no drain being laid under the basement of a house, I ought to point out that the system shown in my diagram is not such as I should advocate were I designing a house. It is such as would be the outcome of rearranging the sanitary arrangements of a house which had been, as most are, built entirely without consideration of the drainage system, and in such the taking of the drains under the basement is often absolutely necessary.

'This brings me on to the remarks of Mr. Rogers Field, who pointed out the necessity for testing drains. I quite agree in this necessity, but contend that even more than that is required. I have seen a drain tested by filling it with water, which it held tightly; but by the end of a year this drain was in as bad condition as ever drain was, the reason being that it was laid on insufficient foundation, which was kept in a continual state of slop during the laying of the pipes, and the condition of which was rendered worse by the testing itself, as the drain was not found to be watertight at the first testing, and allowed many thousand gallons to escape in the vain attempt to fill it. I have during the last twelve months, whenever I have had my own way, had nothing but heavy cast-iron drain-pipes, caulked with lead, laid under the basements of houses. By this means danger of breakage from settlement is reduced to a minimum.

'I am quite aware of the dangers from bath and closet drip tray discharge-pipes connected with soil-pipes, and, had I been speaking to sanitarians, should have enlarged on that and similar subjects, but my desire was rather to point out what are the chief sources of danger than to go into minute details, which only have the result of wasting time and confusing the minds of those not acquainted with the subject.

'With regard to flushing, the necessity for it is self-evident, seeing that the water-carriage system depends on flushing alone for its efficiency. I

nevertheless maintain that if a system is so arranged that it is not efficiently flushed out by the water from the appliances themselves, without special self-acting flushing apparatus, the system is at fault. It is sometimes impossible for the system to be other than at fault in that a sufficient fall is not available for the drain. In such a case self-acting flushing arrangements are invaluable. I have had many of Field's flushing tanks fixed in such cases, and have found their action to be everything that could be desired.

'I quite agree with Mr. Bailey Denton that the principle of separate supply cisterns for closets and drinking purposes has been unnecessarily insisted on. I have before stated in these columns that, with modern closet apparatus and supply valve at the w.c., and not in the cistern, I could not conceive of contamination taking place.

'Certainly the subway arrangement suggested by Mr. Robins is a most perfect one, and one which I should like to see carried out more than it is.

'Mr. Liggins appears to think that the statements of sanitary engineers are exaggerated. I can only say that the figures which I give are strictly correct as far as the 500 old houses inspected by the London Sanitary Protection Association are concerned, and that I believe they would hold approximately good for all houses of the same class in London, and would be greatly increased if houses of all classes were taken into consideration. Possibly Mr. Liggins finds reason to congratulate himself in the fact that his house drain is probably not disconnected from the public sewer, is probably not ventilated, is probably discharging sewer gas into the air of his dwelling rooms, and sewage into the soil under it, that his drinking-water cistern is in direct communication with the drain, and that other arrangements not usually looked upon with equanimity exist in it; but in this he is different, though possibly superior, to ordinary mortals.

'I now come to what Mr. Mineard said. In the first place I must take the most decided exception to his statement that sanitary authorities are disagreed. They are not. In all general principles, and in fact

in all matters except those of the minutest detail, they are remarkably unanimous. I was proud to see at the reading of my paper several of the first authorities on sanitary matters, and was glad to hear most of them join in the discussion. There was not in their case any disagreement on any point of principle. Several of them criticised my treatment of the subject, chiefly on the head that I did not go sufficiently into detail, but none of them objected to any point of principle. Of what nature the 'surveyors' are who have made Mr. Mineard pull down his iron pipes and fix zinc instead, close his manholes, fix bell traps, and connect waste-pipes with soil-pipes, I know not. Certainly they are not sanitary authorities. I shall take the very example of Mr. Mineard's own system of arranging drains, which as widely diverges from the system generally adopted by sanitarians as anything which at all deserves the name of a system does. I have by Mr. Mineard's own kindness seen several houses he has built, and consider that they are drained with the utmost skill and care. I am quite sure that supposing—as I have no doubt—his pipes would stand the tests described, his houses would be guaranteed as well drained by any sanitary engineer of standing. The probability is that such engineer would consider, as I do, that Mr. Mineard's arrangement of a pipe up the front of the house with gas burning in it was an unnecessary refinement.

'In another point I quite disagree with Mr. Mineard. It is not the case that the current of air will generally come out at the lower ventilating opening and in at the upper. In this statement I am sure I shall be borne out by Mr. Field, Mr. Collins, Mr. Bailey Denton, and other gentlemen who were present. For at least ninety-nine out of every hundred minutes the air current will be in the direction indicated in my diagram. As for the hundredth minute no harm will arise from stopping the ventilation altogether. This is easily done by fitting the air inlet with a little appliance, known as a mica flap, which prevents the possibility of an occasional reversal of the current.

'Mr. Mineard stated that he could nowhere find an analysis of sewer gas. He will find several in Mr. Baldwin Latham's book on sewers, and if he care to work out the specific gravity he will find that it is considerably less than that of atmospheric air, chiefly on account of the diminution in the percentage of oxygen, which of the two chief constituents of both air and sewer gas—namely oxygen and nitrogen—is much the heavier.

'A proof, if any be wanting, that emanations from sewage tend to rise is to be found in the fact that in the case of an unventilated lead pipe it is always the upper end which is acted on.'

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